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AUTHOR Pietras, Jesse John
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ABSTRACT

The Connecticut State Legislature enacted telecommunications legislation on July 1, 1994 that will, among other things, enhance distance education in the state. The legislation requires that the state's regulatory utility agency, the Department of Public Utility Control (DPUC) begin dismantling the monopolistic configuration of the existing local exchange network and the individualized components of various subscriber services. Remote educational opportunities in both the cable television and telecommunications technologies are enhanced through the elimination of prior restrictions on two-way cable transmissions, allowing expansion for educational programming purposes. On July 1, 1995, the state adopted a bill that will establish a communications grant program for all public schools and libraries, and established the Connecticut Library Network, a networked expansion of the State Library's existing state-wide database. The following are offered as examples of the state's initiatives in distance education: Telecommunications Incentive Grant (TIG) funding by the Southern New England Telephone Company (SNET), Area Cooperative Educational Services (ACES), SNET's electronic information network, I-SNET, and classroom reconfigurations. Additional legislation established a committee on shared information technology and an educational grant program dedicated to funding projects tied to Connecticut's electronic superhighway, and approved a proposal for a distance learning pilot program and educational information highway which would link 14 New Haven area towns to an interactive video network to be shared among 15 school districts. The influence of telecommunications legislation on remote education and jobs, urban versus rural learning, and multimedia teleconferencing is discussed. Connecticut's communications network infrastructure, always lagging behind the concomitant regulatory and legislative framework, is beginning to develop the broadband capabilities necessary for distance learning, and ultimately will be capable of supporting multiple types of data use and transfer. Five tables illustrate data. (Contains 56 references.) (MAS)

CONNECTICUT ENACTS NEW LEGISLATION DESIGNED TO ENHANCE AND INCREASE INTERACTIVE DISTANCE LEARNING FOR TELEPHONE AND CATV TECHNOLOGIES

Paper Presented at the Connecticut Higher Education Telecommunciations Video Expo on Distance Learning, May 17, 1995, Quinnipiac College, Hamden, Connecticut

Jesse John Pietras
Research Analyst
Department of Public Utility Control
New Britain, CT

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The Connecticut State Legislature, as July 1, 1994, effectuated sweeping telecommunications legislation that will, among other things, enhance distance education in the state. Public Act 94-83, *An Act implementing the Recommendations of the Telecommunications Task Force*, requires the state's regulatory utility agency, the Department of Public Utility Control (DPUC or Department) to begin, among other things, unbundling or dismantling the monopolistic configuration of the existing local exchange network and the individualized components of the various subscriber services.[1] The legislation, among other things, enhances remote educational opportunities in both the cable television and telecommunications technologies. The prior restrictions on two-way cable transmissions, previously reserved for local exchange companies has been expanded for educational programming purposes: "....(D) The two-way transmission of educational or instructional programming to a public or private elementary or secondary school, or a public or independent institution of higher education."[2] This legislation removes the delimitation on cable operators of one-way transmission of cable signals, and eliminates the primary statutory restriction on two-way instructional programming broadcasts. More recently, on July 1, 1995, the state adopted a bill that will establish a communications grant program for all public schools and libraries. *Public Act No. 95-234* provides the regulatory mechanism by which a grant program was effectuated to supply funding for communications projects to public schools and to libraries whose average per capita income is below the state average, of about $40,000. The funding is to be administered jointly by the State Department of Education and by the State Library. The Act also established the Connecticut Library Network, which will be an expansion of the State Library's existing state-wide database, and will make the library's various information resources available statewide via the network.[3]

Telecommunications Funding Programs

The state's primary local exchange company, the Southern New England Telephone Company, (SNET) has endowed, since 1990, a Telecommunications Incentive Grant (TIG).[4] Initially authorized by the General Assembly in 1986 and implemented in 1988, SNET has supplied the TIG funding since 1990 with a $1.5 million grant.[5] The Company has been the primary mover with regard to the implementation of educational telecommunications in the state. In addition to the TIG,

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[1] MCI Telecommunications Corporation Position Paper: Infrastructure Vision Docket. New Britain, CT: Department of Public Utility Control, (August 16, 1994): p. 12.

[2] Substitute House Bill No. 52450: Public Act No. 94-83, An Act Implementing the Recommendations of the Telecommunications Task Force. Hartford, CT: July 1, 1994, p. 6.

[3] An Act Establishing a Communications Grant Program for Schools and Libraries and the Connecticut Library Network. Hartford, CT: July 1, 1995.

[4] SNET Telecommunications Incentive Grant: 1994-1995. New Haven, CT: Southern New England Telephone Company, February, 1994.

[5] Helen Machado, :Next Best Thing to Being There," The Hartford Courant, 156, (80), (March 21, 1994): A1, A4.

SNET has also supplied the I-SNET Learning Leadership Grant. The Company made available grant monies to approximately 20 school districts throughout the state in 1994. Approximately 150 Connecticut schools have received TIG funding since 1988, with the average award being about $2,500. Uses that Connecticut schools have implemented include: enhancement of urban to rural school communication, electronic pen pals, global awareness, and voice mail. Schools have also used the funding to install modems and concomitant software to allow students access to national educational databases. These various remote education protocols are all part of the company's statewide *Links to Learning* remote education program. A statewide map of this program as well as distance learning equipment costs are supplied in the tables at the end this paper.

ACES

Area Cooperative Educational Services (ACES) is a distance learning consortium begun in 1986 as a collaborative effort among the school districts of Amity, Cheshire, Hamden, and North Haven, in the state's south-central shoreline area. The consortium's educational offerings have since expanded to nine courses being offered to 120 students in five school districts.[6] A SNET supplied fiber-optic link allows two-way audio and visual communication among the two of the high schools. The remote paradigm further allows districts whose numbers are increasing to proffer highly specialized courses, such as entomology, while districts with decreasing numbers are able to consolidate certain curricular areas. Recent specialized course offerings have included such highly specialized offerings as astronomy and epistemology.[7] The extant schedule of course offerings is determined by the Consortium's Advisory Committee with input from the Steering Committee. With the operationalization of interactive video systems, additional projected applications include teacher training, informational programs for municipa employees, and adult education.

I-SNET Electronic Information Highway

SNET's ambitious electronic information network, I-SNET, is being touted as Connecticut's version of the National Information Infrastructure. The network will be constructed over 15 years, and has a targeted completion date of 2009.[8] SNET's existing 2,400 mile long fiber optic network network will be the I-SNET backbone, with digital terminals in central offices connected to fiber optic nodes located in neighborhoods of 500 or more homes and businesses. Coaxial cables will link fiber nodes to network interface units attached either to telephone poles or to individual houses. The projected cost for the highway is estimated at approximately $4.5 billion, and since these costs are included in the Company's rate base, they can be reflected and recovered through the Company's existing rate schedules.

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[6] ACES: Distance Learning Consortium Manual. New Haven: Area Cooperative Educational Services, 5pp.

[7] Ibid, p. 4.

[8] Connecticut I-SNET: Introducing Connecticut's information Superhighway. New Haven: Southern New England Telephone Company, March, 1994.

I-SNET will facilitate not only a greater and more complex mixture of entertainment options such as movies and video games, but also such business applications as video teleconferencing, electronic mailings, reports, and photographic images using fast packet switching technology, and of course distance learning. I-SNET will result in wider bandwidth, high speed, high resolution communications, and virtually unlimited range. Various institutions, such as governments, hospitals, and schools will be able, via I-SNET, to interconnect with Local Area Networks (LANS) to access the multimedia applications.[9] The net result of I-SNET will in effect be a high-speed, high capacity, multimedia bridge between suppliers and consumers.

Asynchronous Transfer Mode (ATM) is a fast packet switching technology to be used in the I-SNET infrastructure. ATM combines voice video, and data then transports the information using standard interfacing and switching protocols.[10] One of the ATM drivers is multimedia application, and one of those uses is distance education. I-SNET will speed the evolving paradigm shift in the manner in which people learn, which in turn, will have a substantive impact on the way schools transport their product. I-SNET will transform Connecticut's educational milieu into the "virtual classroom." Made possible by interactive fiber optic links, such a classroom allows teachers and students of all ages and various backgrounds to interact as if they existed in the same actual classroom. Education in the Information Age is changing in the way content matter is disseminated and subsequently assimilated by students from a teacher speaking to a group of students to a teacher speaking to distant student groups through interactive fiber optic networks supporting voice and video communications, in turn allowing document delivery, high-speed graphic calculations, and sophisticated medical resonance imaging techniques.[11]

Classroom Reconfigurations

Cable operators in Connecticut together with SNET are essentially reconfiguring the state's classrooms for the Information Age. Hartford's Bulkeley High School, for example, was recently linked to suburban Hall High, in the affluent suburb of West Hartford to allow audio and visual communications.[12] The Hall-Bulkeley collaboration is but one of 11 cooperative intrastate efforts to use interactive communications technology for curricular enhancement.

Continental Cablevision, located in the upscale, north-central suburb of Enfield, has had interactive remote education up and running for about five years.[13] The fully

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[9] Dusyant Sukhija, "How ATM Will Develop in 4 Market Segments," Communications News, 31, (9), (September, 1994):p. 23.

[10] Alan Stewart, "Bringing ATM Closer to Reality," Communications News, 31, (9), (September, 1994): pp. 16, 21.

[11] "Campus Network Graduates to Fiber Optics," Communications News, 31, (9), (September, 1994), p. 58.

[12] Helen Machado, "Next Best Thing to Being There," The Hartford Courant, 156, (80), (March 21, 1994): A1, A5.

[13] Cable Television in the Information Age. National Cable Television Association: Washington, D. C., 1992.

interactive system interconnects four school districts so that advanced and specialized courses can be taught from one host district to any of the three receiving locations. Continental's system uses two channels enabling subscribers to watch both teacher and students. The system is also connected to the national education program Cable in the Classroom. Cox Cable, headquartered in the east-central town of Manchester, installed return lines several years ago as a franchise renewal requirement to allow the offering of advanced foreign language classes to high schools in the neighboring towns of Glastonbury and in South Windsor. The Cox paradigm allows the offering of specialized and technical courses as Chinese and Russian. The protocol also allows a more general art history class to be taught remotely. Century Cable Management and Century Norwich, two subsidiaries of Century Communications Corporation, have wired about 92% of the K-12 schools in the 12 towns they serve for distance education. Century's *Model School Technology Program*, scheduled to be functional by the end of 1995, will supply a designated franchise area school with a full range of interactive cable resources, such as high speed, broadband data transmission, and multimedia computer networking.[14]

Legislation and Distance Learning

One particularly appealing aspect of the new interactive distance learning technology lies in its ability to afford the more rural systems to take courses that would otherwise be unavailable, such as advanced foreign languages and advanced statistics.[15] Interactive remote education is pricey-the costs for high schools may range between $110,000 and $150,000 to purchase equipment such as modulators and demodulators, and to connect the fiber optic lines that supply the interactive capability. Schools may also spend another $40,000-50,000 in yearly access fees to local exchange companies in addition to hiring supplemental staff to maintain the system. The new technology works well for subjects such as foreign languages, but not quite as well for composition courses, due to the inherent nature of the content material. Additionally, experts caution that whether or not interactive capability actually is the most successful remote education component is uncertain. Carla Lane, project director for the San Francisco based Distance Learning Resource Network has evaluated distance learning and has stated: "The question of interactivity is still not answered. Two-way is a heck of a system, but do we need it? I don't know of any studies that have shown it."[16]

In Connecticut, a legislative proposal that would have promoted economic development and education via the emerging information highway died when it was not acted upon during the 1993 winter session. The legislation, which was revived during the winter, 1995, legislative session, revised, and was subsequently passed and implemented on July 1, 1995, established a committee on shared information technology and an educational grant program dedicated to funding projects tied to

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[14] Michelle M. Bella, "Case Study: How Century Does It," Distance Education and Cable Television, 4, (2), (May, 1995): p. 7.

[15] Micheal Winerip, "Classrooms on the Information Highway," The New York Times, 143, (49,763), (June 20, 1994): B7.

[16] Brian Miller, "Distance Learning:Much Closer," Government Technology, 8, (7), (July, 1995): 18-19.

Connecticut's electronic superhighway.[17] Connecticut has already has extant regulations pertaining specifically to remote education that provide a general framework for quality standards on instructional and educational channels generally shown as part of local origination programming, or of community access television. These regulations went into effect in May, 1993, and are included in each cable franchise operator's franchise renewal agreement authorized by the Department and state:

> The provision of educational and instructional channels with a bi-directional full-motion video and the availability of educational channels via return lines for the entire franchise community....and the availability of interconnection across franchise boundaries.[18]

These regulations were promulgated in order to bring the Department's regulations into compliance with Public Act 92-146. That legislation required the Department to rule on the extent to which a cable franchise operator's distribution plant should be used to effectuate interactive remote educational protocols.[19] That legislation charged the DPUC with establishing:

> ....Quality standards for the provisioning of instructional and educational programming, including credit and no credit instructional programs for the general public.16.

Additionally, The State Department of Education has proposed draft guidelines for the use of educational technology in the schools that seek to establish new links between educational technology and telecommunciations, since Connecticut does not yet have legal guidelines for the use of educational technology in the public schools. The idea is to facilitate access to and use of informational technology in Connecticut schools. Still in the draft stage, the guidelines are expected to be ready for the start of the 1995-'96 school year.[20]

Emerging Educational Protocols

Knowledge Plus is a $1.3 million, 1-year, distance learning pilot program and educational information highway proposal that was recently approved by the state legislature. If approved, this interactive video network would link 14 New Haven area towns to an interactive video network to be shared among 15 school districts.[21] Every participating municipality, school, and job training center would have the ability to connect to the international networks, such as the Internet, as well as access to the Internet from individual personal computers. Coaxial cable and 56kb, T1, lines will

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[17] Raised Bill No. 340, An Act Connecting Connecticut to the Electronic Superhighway. Hartford, CT: March 3, 1994. (Bill died, 3/22/94)

[18] "Quality Standards for Instructional and Educational Channels," Regulations of Connecticut State Agencies, Section 16-333-42(b). New Britain, CT: Department of Public Utility Control, April, 27, 1993.

[19] An Act Concerning Educational Programming. Hartford, CT: May 27, 1992.

[20] Richard S. Krissinger, Draft Guidelines for Educational Technology. Paper Presented at the CABE/CAPSS Educational Technology Convention, January 5-6, 1995, Waterbury, CT. 3pp.

[21] Karla Schuster, Internet Hookup May Link Towns," The New Haven Register , 229, (August 17, 1994): B1, B3.

most likely would allow the connections from the school districts and towns to the Internet, but no technical specifications can be delineated until funding is approved in December, 1994. The proposal was developed by the South Central Regional Council of Governments and was recently approved by the State Department of Economic Development and the State Department of Education. The final step in the process is action by the State Bond Commission for the financing of the project. The *Knowledge Plus* protocol will not use the existing ACES fiber optic backbone, but will offer educational transmission capability through school districts' existing Local Area Networks. Funding would be available for districts to construct such networks if they do not already exist.

SNET is currently conducting video-on-demand trials in the central Connecticut town of West Hartford, and in affluent Fairfield county. It is not a technology trial per se, and the methodology is crude, making use of 115 mechanically loaded VCRs to supply the actual programming.[22] SNET recently received FCC approval to expand its trial throughout the state, and ultimately, the technology could be upgraded to encompass various educational applications. Particularly in Connecticut, video-on-demand's educational potential is strong with about 77% of the state's homes being cable-connected as compared with approximately 60% nationally, this being, by some estimates, the highest cable penetration level in the country.[23] The sine qua non of an eventual statewide interactive information highway may well be the state's high level of cable television and telephone penetration, the latter which presently stands at 97.5%, slightly above the national average of 95.6%.[24] The video-on-demand trial expansion was contested by cable franchise operators as an unfair form of competition for the cable business, but that claim has been abrogated by the FCC rulings that have given SNET permission to expand the trials.

Legislative Enhancements

Recent federal legislation removed the ban on cable/telephone cross ownership restrictions as well as allowing telcos to offer video services in local exchange company areas.[25] The sine qua non of this issue revolves around the extent to which a regulated monopoly such as a telephone company and a virtual monopoly like a cable company can be allowed to compete for the same customer while keeping subscriber rates artificially low, much the way the intrastate toll rates have traditionally subsidized local exchange rates, keeping them artificially low. However, with the advent of cable/telco deregulation, and with competition now a reality in the local telephone exchanges, the

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[22] "High Tech Video on Demand is on its Way," The New Britain Herald, 191, (August 15, 1994), p. 20.
[23] Bill Keveney, "The Cable Frontier," The Hartford Courant, 156, (171), (June 20, 1994): B1, B3.
[24] FCC Monitoring Report. Washington, D. C. Federal Communications Commission, CC Docket No. 87-339, May, 1994. p. 23.
[25] Fred Rogers, "Will the Information Superhighway be a Toll Road?" Communications Technology, (April, 1994), pp. 60-63.

distinction between cable and telephony will continue to blur. Add into this equation the public demand for the creation of institutional networks and other education-based paradigms, and the result could be increased subscriber rates due to more capital expenditures the operator might incur due to the plant a cable operator may construct for the distance learning or other institutional networks. The result could be some form of rate increase passed through to subscribers so the operator can recover its construction costs, in the traditional social contract sense; i. e, all subscribers, whether premium or basic, paying for the betterment of overall quality and diversity of cable programming. It remains to be seen whether Congress will deregulate the industry once more, and to what extent that will affect capital expenditures.

Further clouding the instructional programming picture is whether a statewide inter-cable franchise institutional network with fiber-optic links to SNET's 2 million access lines may undermine the federal government's intention that instructional channels should be dedicated for only local origination or for local access purposes.[26] Connecticut's businesses are contributing more and more to the establishment of remote educational networks, a recent example being the contribution of $12,300 from the General Electric Corporation to the Plainville Middle School in central Connecticut. The school subsequently purchased a satellite dish to receive signals and to link the facility to the University of Connecticut.[27] This protocol is currently functioning with an interactive link from the local cable company. The satellite feed is 1-way only for reception. A mid-term franchise review will make that link two-ways to facilitate transmission as well as reception.

The state's 26 cable franchise operators, of which about 14 presently have some type of functioning remote education program, serve over 1,000,000 subscribers. SNET is also responding to the increasing need for remote education, despite the state's small geographical size.[28] A recent DPUC ruling stated that Comcast, a cable affiliate serving communities along the Connecticut river:

{Comcast} shall indicate....how it intends to work with educators....to support and commence the incorporation of distance learning and other educational community cable-related needs.[29]

Some communications experts have contended that Connecticut is on fast path to the information superhighway, I-SNET and the West Hartford video-on-demand trial both being prime examples. The DPUC has implemented a series of regulatory proceedings covering issues as diverse as universal service, low-income assistance

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[26] DPUC Feasibility Study of Bi-Directional Transmission of Educational and Instructional Programming: Comments of Nutmeg Public Access Television, Inc. New Britain, CT: Dept. of Public Utility Control, Docket No. 93-07-09, September 30, 1993 p. 7.

[27] "Learning Center Planned with G. E. Grant," New Britain Herald, September 15, 1992, p. 13.

[28] Department of Public Utility Control:Briefing Book. New Britain, CT: DPUC, December 6, 1994, p. 7.

[29] Connecticut Department of Public Utility Control, Comcast Cablevision of Middletown, Inc., Franchise Renewal Proceeding. (Decision) Docket No. 89-06-03, May 15, 1991, p. 5.

programs, and coin telephones. The state's Office of Consumer Counsel recently stated:

> Theoretically, it (increased competition) should be good for the consumer if there is more competition and more choices....But nobody can tell you that for sure now. It is a very complex issue. It depends on how the implementation of the new legislation all shakes out.[30]

The legislative impetus to deregulate telephony and to open competition between telephone and cable companies indicates that there will be immediate, substantive, overhaul of the nation's 60 year old communications law.[31] The upshot of that decision could be that technology-driven changes, such as the incipient video-on-demand assays will proceed, and that technological innovations will progress more quickly and comprehensively. Since deregulation means that ultimately local exchange carriers such as SNET will be able to acquire cable companies in their own service markets, and supply programming, the extant video-on-demand trials are nonetheless a harbinger of the inevitable demise of that regulatory prohibition.

The current battle for dominance in the information highway war in the central part of the state seems to be between SNET and TCI, (Tele-Communications Inc.) the nation's largest multiple systems cable franchise operator.[32] Both companies are currently introducing video-on-demand services, which have ostensibly marked the beginning of digital television programming in Connecticut and also the start of cable-telco competition, particularly with regard to the provisioning of video programming. The language of the legislation that has paved the legal path for beginning competition in the local exchange also addresses educational and instructional programming. It states:

> The two-way transmission of educational or instructional programming to a public or private elementary or secondary school, or a public or independent institution of higher learning, as required by the Department pursuant to a community antenna television company franchise agreement.[33]

Connecticut is preparing for the interactive video revolution both technologically and financially. SNET's TIG program has supplied over $40,000 to plan and to implement instructional telecommunications paradigms.[34] Besides SNET, Woodbury Telephone, a small local exchange carrier serving a few rural communities, also offers TIG funding

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[30] Eve Nagler, "Mapping the Telephone's New Uses" The New York Times, 144, (49,830, (September 25, 1994): 13: 1, 7.

[31] Ted Hearn, "Sweeping Telecom Bill Passes House," Multichannel News, 16, (32), (August 7, 1995): 1, 45.

[32] Kathleen Gorman, "Great Cable War to Beam Down on West Hartford,", The Hartford Courant, 146, (96), April 6, 1994): C1, C11.

[33] An Act Implementing the Recommendations of the Telecommunications Task Force. Hartford, CT: Public Act No. 94-83, July 1, 1994, p. 6.

[34] SNET Telecommunications Incentive Grant, 1994-1995. New Haven: Southern New England Telephone Company, February, 1994.

for the school districts it serves. Funding is restricted to communications projects via the extant telephone networks. All the state's public, vocational, technical, and regional educational service centers are eligible to apply for the funding.

Remote Education and Jobs

The United States and other leading industrialized nations recently agreed that the best way to create skilled jobs to upgrade education, particularly for the unskilled, is to supply the educational base to re-tool people for the more highly skilled technical positions.[35] This is critical in Connecticut, where national defense cutbacks in nuclear submarine construction have crippled the economies of the state's southeastern shoreline towns such as New London, Groton, and Mystic, as the Cold War ended and demand for the ships has been greatly truncated. Several major insurance carriers have sustained heavy losses, and as a result, have laid off staff. Additionally, new technology, ranging from robotics to the information highway is creating an ever widening gap between skilled and unskilled workers, with more of the unskilled being unemployed due to low educational levels and the inability, due to lack of technical training, to re-tool. The problem is to balance higher education, advancing technology, and improved productivity with low unemployment. Norbert Blum, Germany's Minister of Labor and Social Affairs recently stated:

> I think it is a false belief that well-trained and qualified people are not endangered by unemployment....We should be ready to retrain at any time. Retraining is the duty of management.[36]

Continental Cablevision, Inc., the nation's third largest multiple system operator behind TCI and Time-Warner, has recently begun offering a high-speed link to the Internet through the same coaxial cables that carry television channels into the home.[37] Continental's Connecticut affiliate, Continental Cable of Enfield has had an institutional network functioning since 1987.[38] Continental's remote educational system is fully interactive, real-time, two-way video. The protocol allows that if sufficient interest exists for an advanced course, a teacher in one school district may teach the course to students in another district. The paradigm uses two channels so that subscribers may watch either the students, the teacher, or observe both. Students interact with their peers and with teachers simultaneously. This model has allowed the offering of technical and specialized courses that otherwise would have been unavailable.

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[35] Thomas L. Fredman, "Accent on Education as Talks on Jobs End," The New York Times, 143, (49,637), (March 16, 1994): D1, D2.

[36] Ibid., D2.

[37] Peter H. Lewis. "Big Cable Company to Offer a High-Speed Internet Link," The New York Times, 143, (49,630), (March 9, 1994): D1, D2.

[38] Twenty-First Century Television: Cable Television in the Information Age. National Cable Television Association, Washington, D. C.: 1994.

Urban-Rural Learning

Connecticut's evolving information infrastructure is enabling the state to narrow the gap between its rural northeastern section and its crowded north-central corridor. Pomfret, a town of about 3,000 in the northeastern quadrant, recently began an interactive video link with Bridgeport, an inner city of about 135,000. Primarily white Pomfret students are beamed from the University of Connecticut's main campus in Storrs while the predominately black Bridgeport students are broadcast from the university's Stamford campus. The two groups, comprised from entirely different socio/ethnic backgrounds, are able to interact and discuss topical issues.[39] Pomfret School Superintendent Tim James stated about the program: "Awareness is probably the biggest thing. It's the one thing we thought we could really deal with."

The urban-rural gap is exacerbated in many small Connecticut towns such as the Connecticut river town of Ivoryton, where the information highway on-ramps of CompuServe, America On-line, and Prodigy simply do not exist except through a toll call. These residents are denied equal access to such on-line services because the networks, though well-developed in metropolitan areas, are not available in the more rural districts due to lower population densities, and higher installation costs for the necessary distribution plant. Further compounding the problem in small shoreline communities such as Old Saybrook and Essex are smaller local calling areas. Hartford residents, in contrast, can reach three dozen surrounding communities with one toll-free call, while Old Saybrook residents can reach only four.[40] It is uncertain how this problem will ultimately be alleviated. Elsewhere, Berlin, a rural central Connecticut community, has used a $3,300 SNET/TIG grant to connect all five public schools in its system.[41] The town was one of 20 Connecticut schools receiving TIG money for some type of remote education telecommunications project in 1994.

SNET recently sponsored a two-day electronic symposium on April 27-28, 1995, that allowed five Connecticut high schools to discuss the movie *Schindler's List*. Students participated interactively from their respective classrooms in North Haven, New Haven, Hamden, Cheshire, and Woodbridge, all located in the south-central part of the state. The discussions were carried over fiber-optic cable and used advanced digital technology that supplied the broadband capacity that such interactive video paradigms require.[42] Connecticut's demographics and small geographical area make

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[39] Susan Campbell, "Video Hookup Helps Kids Reach Out Across Miles," The Hartford Courant, 156, (318), (November 14, 1994): E1, E2.

[40] John M. Moran, "Millions in Small Towns Left Off-Line by Computer Networks," The Hartford Courant, 154, (339), A1, A7.

[41] Sandra James, "Berlin Schools Prepare to Make A Connection," The Hartford Courant, 156, (287), (October 14, 1994): B1.

[42] "SNET Sponsors High-Tech Discussion for Students." (News Release) New Haven, CT: Southern New England Telephone Company (April 26, 1994)

it receptive to transmit the expanded voice, video, and data services that the I-SNET architecture will ultimately offer to the state.[43]

Multimedia Teleconferencing

In Connecticut as elsewhere, multimedia teleconferencing figures to be the killer application of the Information Age.[44] Today's prevailing distance learning paradigm gives the teacher all the bandwidth. Students generally get a voice-only return path through a telephone line. One way to enable schools to tap into multimedia teleconferencing is through the use of such software as *Virtual Meeting*. This paradigm allows users to share files and conference in real time via remote sites using LANS, telephone lines, or any other communication pathways. Further enhancing the distance education scenario in Connecticut is the recent decision by the Department to allow an alternative cable franchise operator to construct a cable network where there is already an operator. *FiberVision*, the cable entity given permission last April by the DPUC to construct a network in a TCI affiliate's franchise territory, has committed to link all public school and town libraries in its franchise area, as well as the technical link to allow the programming, but of course, not the programming itself. Joseph McGee, outgoing Connecticut Economic Development Commissioner, recently stated:

{I-SNET} remains a big maybe. Maybe customers want it, and maybe they're willing to pay for it. But it's possible that they're not.[45]

The small, rural community of Plymouth recently approved a plan to combine resources with other districts with the greater Waterbury region to improve educational quality and cultural diversity. Among other things, the Plymouth plan includes linking its schools via a single interschool computer network to effectuate the use of distance learning.[46] What the network builders are envisioning in Connecticut as elsewhere are the prominent computer applications: video-on-demand, home shopping, interactive games, and direct response advertising. But there are also the society-transforming social contract applications such as telemedicine, distance learning, and telecommuting. The vision of the "fully wired society" is predicted to become a dynamic force for social good and result in enhancing education, medical care, and the improvement of communications. However, distance learning and information-on-demand probably will not be available for mass public consumption until interactive television takes off, and that remains several years away.[47] New technologies such as digital signal compression and ATM will make interactive protocols such as remote education both cost effective and widely available. Left to their own devices, cable

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[43] Susan E. Kinsman, "SNET Makes Bet on its Future," The Hartford Courant, 156, (217), (October 24, 1994): B1, 12-13.

[44] David Thornburg, "Why Wait for Bandwidth?" Electronic Learning, 14, (3), (November-December, 1994): pp. 20-23.

[45] Jim Motovalli, "Cable Wars," Connecticut Magazine, 57, (4), April, 1994): pp. 37-41.

[46] Matthew Brown, "School Diversity Plan Approved," The Hartford Courant, 156, (300), (October 28, 1994): B6.

[47] Charles Piller, "Dreamnet," MacWorld, (October, 1994): pp. 2-11.

franchise operators would probably "creamskim," that is, serve the richest, most densely populated neighborhoods, such as the "Gold Coast" of Fairfield County. The Federal Government has managed to connect schools, public libraries, and hospitals to the various interactive technologies, but has not yet figured out how to link up everyone else.[48]

A recent study of Connecticut's college enrollment by the State Department of Higher Education found that fewer than 50,000 of the 16,367 students enrolled at public and private colleges are 17-21 year olds attending college full-time. Only about 14.5% of the undergraduate population at the state's main university campus in Storrs is under 25 years old, and only about 4.6% of undergraduates at the state's private schools that recruit nationally-Wesleyan, Yale, Connecticut College and Trinity are under that age. Recent figures state that U. S. public schools have about 5.8 million computers. In Connecticut, this averages to approximately one computer for every nine students. According to the state's Joint Committee on Educational Technology, science can be: "a key factor in improving education and....producing a competent and technically literate work force."[49] Technology is not a panacea, however. As Yale computer scientist and biblical scholar David Gerlenter states: "We are producing children who don't know important things like history. The last thing we should be wasting our time on is a frivolity like computers."[50] It is important to realize that the mere proliferation of computers in classrooms does nothing to ameliorate such serious problems as overcrowding, teacher incompetence, and lack of job security. The problem is that in Connecticut as in other industrialized states, higher education is structured to serve the traditional rather than the older, working, non-traditional college student.[51] Strategies such as networking throughout the elementary grades expand the opportunities for distance learning and for instructional television programming. Two standard, 6MHz channels, one for upstream and one for downstream transmission will allow the interactivity and thus facilitate the functioning of the remote education protocol.[52]

There is no question that education is enhanced through the use of advanced technology and through interactive learning. Quite simply, interactivity links allow resources at one educational site to be used at another.[53] Technologies such as ATM can facilitate the interconnection of thousands of educational sites with interactive distance learning programs, database access, teacher training, telemedicine, prisoner education, town meetings, video teleconferencing, etc. Connecticut has erected the regulatory and legislative framework for the provisioning of a statewide interconnected

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[48] Philip Elmer-DeWitt, "Play...Fast Forward...Rewind...Pause" Time, 143 (21), (May 23, 1994): 44-46.

[49] Robert A. Frahm, "Reading, Writing, and ROM," The Hartford Courant, 157, (218), August 6, 1995): A1, A8, A9.

[50] Ibid., p. A9.

[51] Katherine Farrish, "Young, Full-Time College Students in Minority" The Hartford Courant, 156, (75), (March 16, 1994): D1, D11.

[52] Michael Angelo, "Implementation of Data and Communications Services," Communications Technology, (December, 1994): pp. 58-62.

[53] Patrick E. Lanthier, National Information Infrastructure Public Policy White Paper: Route 94:Information Superhighway Public Policy Road Map. Paper presented at the Rutgers Center for Research in Regulated Industries, 13th Annual Conference, Newport, RI, May 25-27, 1994. 11pp.

educational network with the coming of I-SNET, and the gradual tying together of the 26 cable franchise operators' individual institutional and governmental networks.[54] Up-front technology-based grants may partially offset capital intensive networking costs, and with remote educational projects such as *Knowledge Plus* now being funded and implemented, school districts, libraries, and higher educational institutions across the state will have electronic learning capability virtually at their doorsteps. As the pilot program for Connecticut's south-central regional districts, *Knowledge Plus* will serve as a testing ground for research and development of remote education that can used statewide to bring advanced learning technology not only to schools, but to libraries, colleges, universities, and to the communities to raise the levels of learning and the standard of life in Connecticut. The deliverables will include internetworking, Internet access of public schools, and the linking of schools, towns and libraries in the south-central region as well as throughout the rest of the state. Connecticut stands poised and ready to meet the Information Age and its concomitant technological onslaught.[55]

Conclusions

The Department believes that it is the responsibility of the regulated entity, be it a cable operator, or a local exchange company, to address the instructional and educational needs within its franchise through the provisioning of facilities and equipment necessary for technologically advanced educational programming, where such needs have been identified as an integral and substantive part of the overall community needs. The educational needs must be viewed on an equal footing along with the mandated governmental and public access channels and now with instructional and educational programming. The question of cost allocations and capital expenditures for the necessary equipment and distribution plant for educational production and origination, including classroom equipment, personnel, and in-kind support services is a complicated issue, but remains largely the responsibility of the municipalities and of the local educators, and the funding commitments for these expenses are most properly addressed by the germane educational agency. This is particularly relevant in light of the current movement for deregulation. It is for the Department to balance the magnitude of support to be supplied, and to oversee the appropriate determination of cost allocations between the company and the educational entities.

A recent survey of Connecticut public school principals indicated that even now there are copious problems in accessing information. For example, very few Connecticut school computers are actually linked to functioning information networks, existing wiring in Connecticut's public schools cannot accommodate high-speed, broadband information transfer, and about one-fourth or fewer of Connecticut public school teachers, for the most part, have been inadequately trained in the proper use of

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[54] Regional Forum No. 3 for Quality and Diversity in Education. Hartford, CT: Public Act 93-263: September, 1994, p. 9.

[55] Knowledge Plus Project Proposal. Area Cooperative Educational Services, New Haven, CT: December 6, 1994.

advanced technology for instructional and classroom management purposes.[56] Additionally, many school boards have not yet adopted a comprehensive plan for implementing advanced technology in their schools, and many educators are not facile with various technological modalities. State and local officials, including school board members, political leaders, and legislators will continue to have the primary responsibility of supplying proper financial and governing leadership for schools. Remote education is poised to radically transform not only education, but also healthcare, medical science, scientific, educational, military, and industrial sectors of the society. Educators and elected officials will be responsible for effectuating educational reforms through the evolving technologies, and consequently will need to be extremely conversant with present and developing technologies, as they expand into the next century. Learning has evolved, for better or for worse, as more than mere memorization and dissemination of textbook-grounded content material. The Internet, satellite uplinks and downlinks, electronic libraries and telecourses are now nearly as common as textbooks. The new high-tech educational environments enhance learning in the sense of the classroom serving as a proxy for real-world training so as to prepare students for legitimate jobs upon graduation. A protocol such as Cost Effective Distance Learning (CEDL), for example, is a low cost, relatively low-tech paradigm that facilitates distance learning using only one telephone line. CEDL is designed to be used by only one teacher, and thus is an application that makes sense, particularly when education budgets are strained to the limits.[57] The system is currently being used in Utah at Salt Lake City Community College.

In Connecticut as in other states, the abandonment of that traditional informational icon, the library card catalogue, is indicative of the advent of such computerized information systems as *CARL* , the Colorado Alliance of Research Libraries. This storage and retrieval database now is functioning in about 3,600 of the nation's nearly 90,000 public libraries, as many states such as Connecticut face the very pragmatic problem of what to do with the old card catalogue cases.[58] It thus evident that the Information Age is developing quickly in Connecticut, both legislatively and technologically. The state still has many technical obstacles to overcome, such as archaic school buildings and computer dysfunctional teachers, as well as strident opposition from many teachers' unions to computerized distance education. However, according to the recent *Strategic School Profiles*, Connecticut's elementary schools have been big recipients of computers in the last three years, although the problem remains of convincing local boards of education and politicians of their utility to justify their formidable expense.[59] Be that as it may, Connecticut remains at the forefront of

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[56] Janet M. Grenzke, Our Children's' Schools: Are They Good Enough? A Report on the Survey of Connecticut Public School Principals. Hartford, CT: Abacus Associates, April 26, 1993. pp. 1-5.

[57] Julie Slama, "Community College Blossoms Big with Technology," Communications News, 32, (7), (July, 1995): 28-29.

[58] Fran Silverman, "Librarians Find New Life for Old Symbol of Information Highway," 157, (37), (February 6, 1995): A3, A8.

[59] Margaret Tierney, "Computers Part of Basiscs at Area Schools," The Hartford Courant, 156, (360): B1, B2.

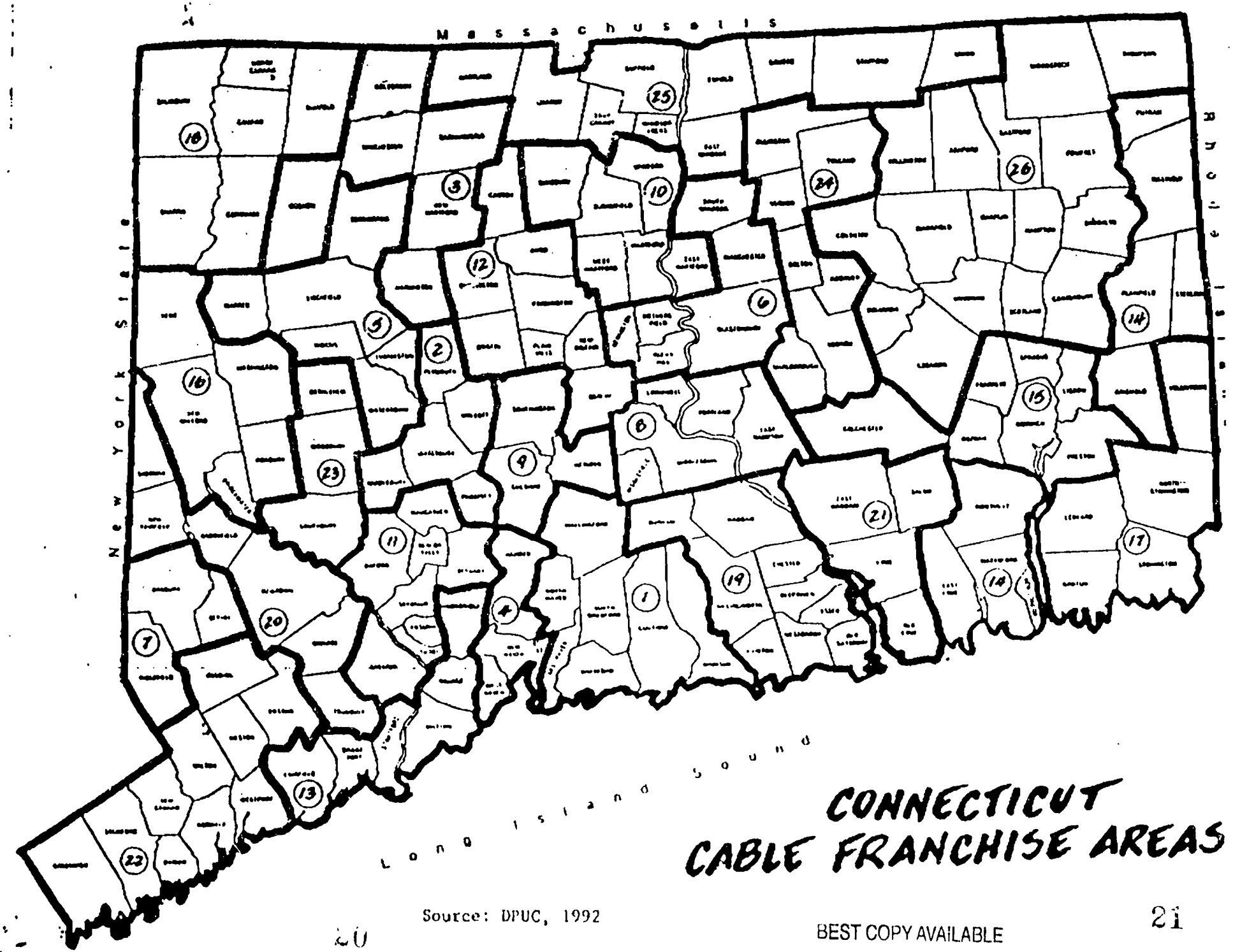
the information revolution, and guided by the regulatory hand of the Department, and spurred by the technological innovation that competition fosters, figures to remain in that position into the coming century. Connecticut's communications network infrastructure, always lagging behind the concomitant regulatory and legislative framework, is now beginning to develop the broadband capabilities necessary for distance learning, and ultimately will be quite capable of supporting multiple types of data use and transfer.

Legend To Table A

Cable TV Company Name	Company Number
TCI Cablevision of South Central CT	1
Sammons Communications	2
Pegasus Cable Television	3
Storer Communications of Groton	4
Laurel Cablevision	5
Cox Cable of Greater Hartford	6
Comcast Cablevision of Danbury	7
Comcast Cablevision of Middletown	8
Telesystems of CT	9
TCI Cablevision of Hartford	10
Tele-Media of Western (Valley)	11
TCI Cablevision of Central CT	12
Cablevision of Southern Connecticut	13
Eastern Connecticut Cable Television	14
Century Norwich Corporation	15
Crown Cable New Milford	16
Storer Communications of Groton	17
TCI Cablevision of Northwestern CT	18
Storer Communications of Clinton	19
Crown Cable-Housatonic	20
Century Cable Management Corporation	21
Cablevision of Connecticut	22
Crown Cable Mid-CT	23
TCI Cablevision of Eastern Connecticut	24
Continental Cablevision	25
Tele-Media of Northeastern CT	26

Source: DPUC, 1993

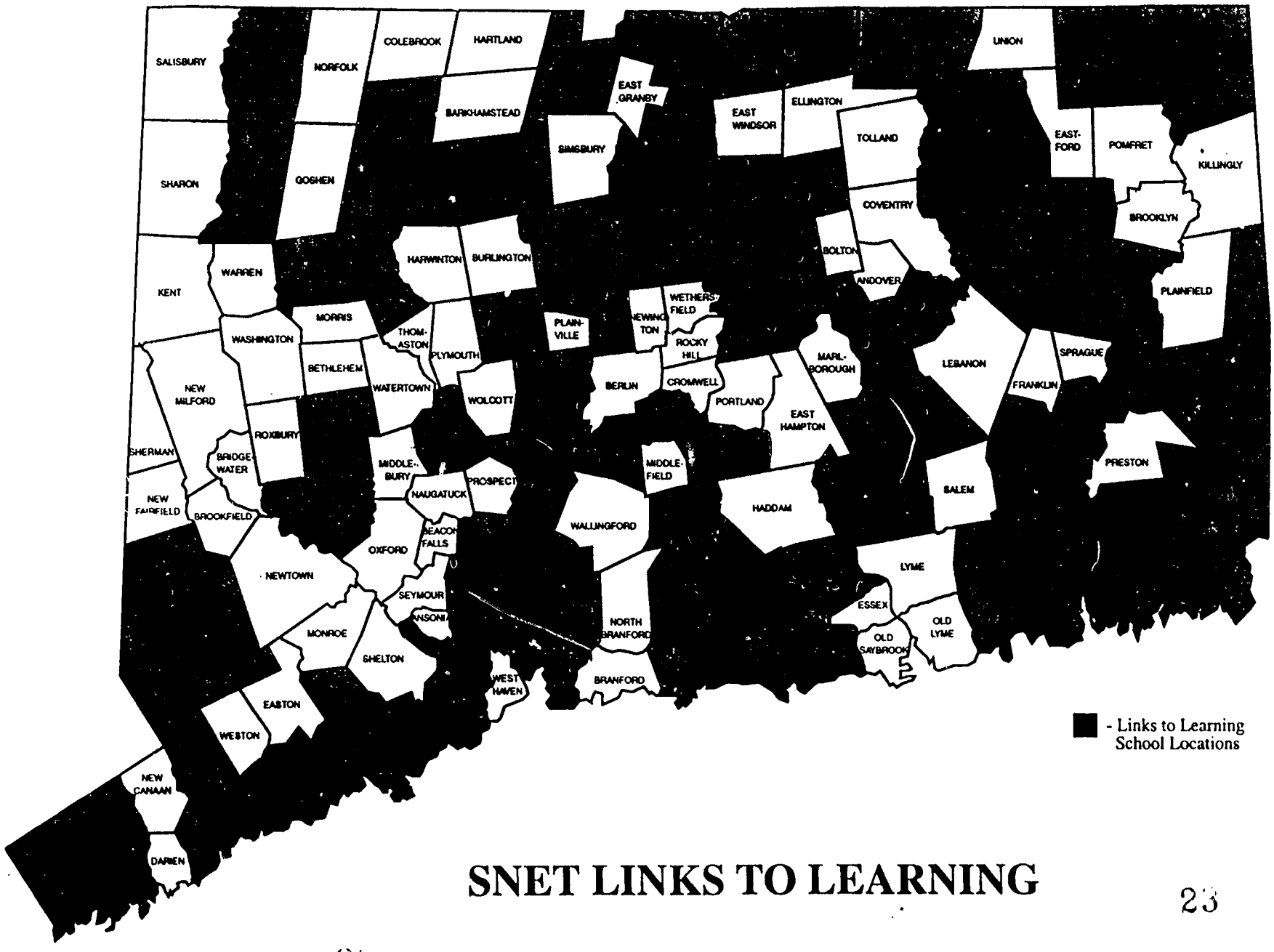
TABLE A



CONNECTICUT
CABLE FRANCHISE AREAS

Source: DPUC, 1992

TABLE B



SNET LINKS TO LEARNING

TABLE C

CABLE CLASSROOM EQUIPMENT COSTS
Four year acquisition plan for one site

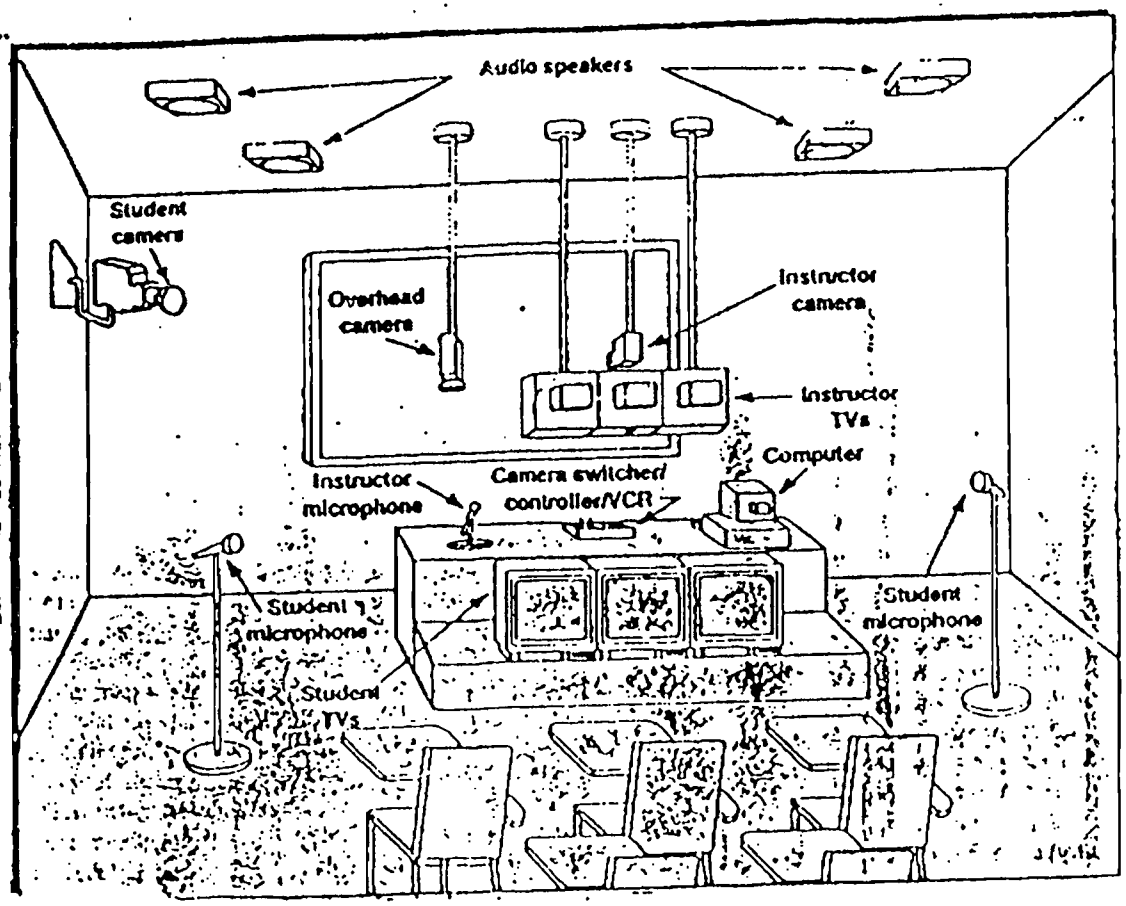
Year 1- Minimum Receiving Site	5,375.
Year 2- Fully Equipped Receiving Site	4,425.
Year 3- Minimum Origination Site	4,890.
Year 4- Fully Equipped Origination Site	995.
	$15,685.

Cable company pays for:	
"Upstream" modulator	2,250.
Headend demodulator	2,300.
Programmable timer	700.
Switching matrix	400.
	$5,650.

Source: Middlesex Distance Learning Consortium, 1990

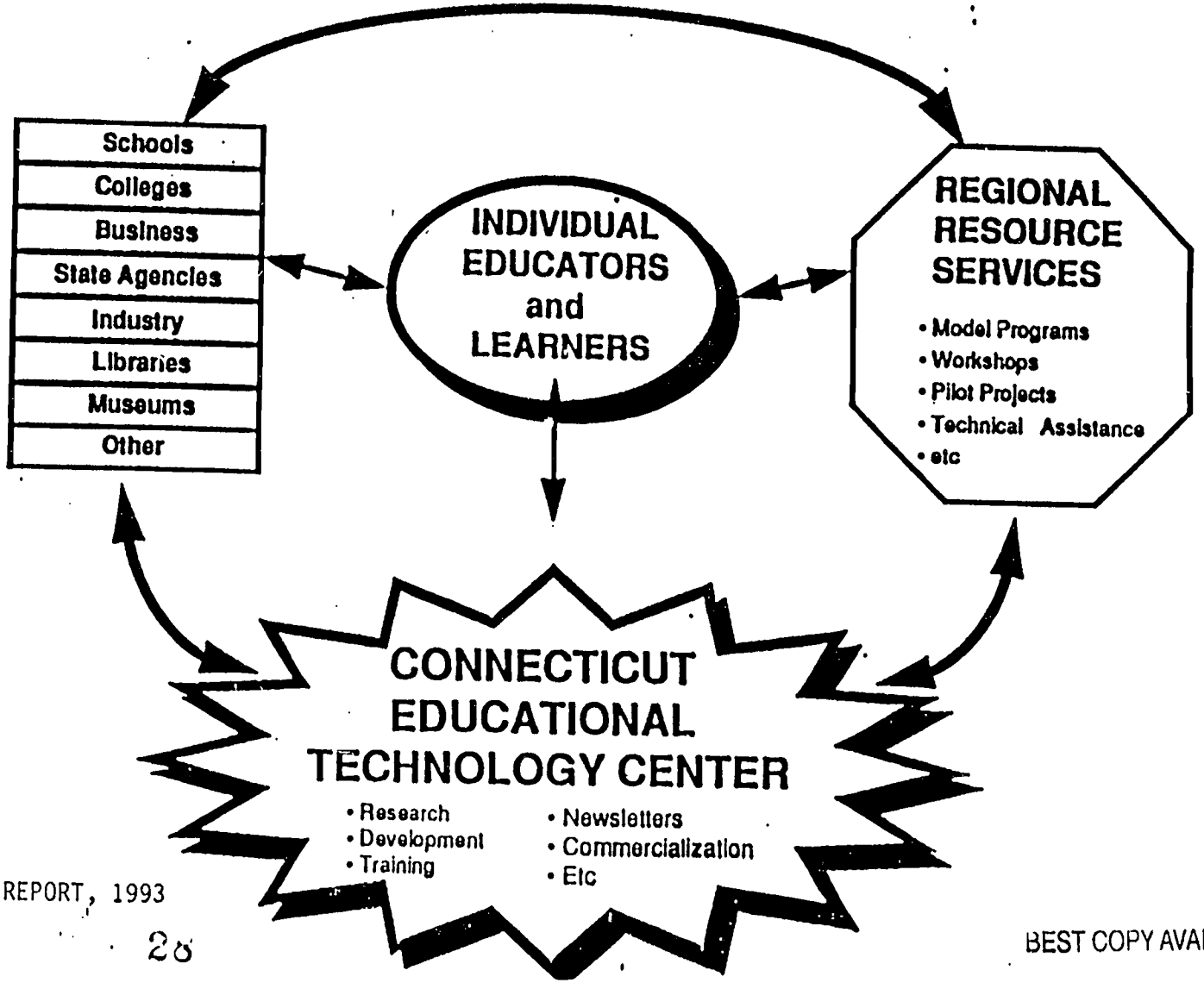
TABLE 1

This two-way interactive classroom can function as either a sending or receiving site.



Source: Linking for Learning, Office of Technology Assessment, 1991.

CONNECTICUT EDUCATIONAL TECHNOLOGY PROPOSED INFRASTRUCTURE



SOURCE: JCET ANNUAL REPORT, 1993